

WHAT IS CLAIMED IS:

1 1. A differential interferometric confocal microscope for measuring an
2 object, said microscope comprising:
3 a source-side pinhole array;
4 a detector-side pinhole array; and
5 an interferometer that images the array of pinholes of the source-side pinhole
6 array onto a first array of spots located in front of an object plane located near where the
7 object is positioned and onto a second array of spots behind the object plane, wherein the
8 first and second arrays of spots are displaced from each other in both a direction normal
9 to the object plane and a direction parallel to the object plane, said interferometer also
10 imaging the first arrays of spots onto a first image plane that is behind the detector-side
11 pinhole array and imaging the second array of spots onto a second image plane that is in
12 front of the detector-side pinhole array wherein each spot of the imaged first array of
13 spots is aligned with a corresponding different spot of the imaged second array of spots
14 and a corresponding different pinhole of the detector-side pinhole array.

1 2. A differential interferometric confocal microscope for measuring an object,
2 said microscope comprising:
3 a source-side pinhole array;
4 a detector-side pinhole array; and
5 an interferometer that images each pinhole of the source-side pinhole array onto a
6 corresponding different pair of two locations, one of which lies in a first object plane and
7 the other of which lies in a second object plane that is parallel to and displaced from the
8 first object plane, thereby generating a first image of the source-side pinhole array in the
9 first object plane and a second image of the source-side pinhole array in the second object
10 plane, said interferometer also projecting a first array of return measurement beams from
11 the first image and a second array of return measurement beams from the second image
12 toward the detector-side pinhole array to produce a first array of converging beams and a
13 second array of converging beams, wherein the detector-side pinhole array generates an

14 array of conjugated quadratures of fields that is a difference of conjugated quadratures of
15 fields of the first and second arrays of converging beams.

1 3. A differential interferometric confocal microscope for measuring an object and
2 which has, in the vicinity of where the object being measured is to be located, a first
3 object plane and a second object plane that is displaced from and parallel to the first
4 object plane, said microscope comprising:
5 a source-side pinhole array;
6 a detector-side pinhole array; and
7 an interferometer that receives a beam from a selected pinhole of the source-side
8 pinhole array and converges a first part of that received beam onto a corresponding first
9 location in the first object plane and a second part of that received beam onto a
10 corresponding second location in the second object plane, said interferometer also
11 arranged to receive a first return beam from the first location and a second return beam
12 from the second location and converge at least a part of each of the first and second
13 return beams onto a corresponding pinhole of the detector-side pinhole array to produce a
14 difference of conjugated quadratures of fields of the first and second return beams
15 converging on that corresponding pinhole,
16 wherein said selected pinhole is any pinhole of the source-side pinhole array.

1 4. A differential interferometric confocal microscope for measuring an object,
2 said microscope comprising:
3 a source-side pinhole array for producing an array of input beams;
4 a detector-side pinhole array; and
5 an interferometer including:
6 a first optical element providing a first reflecting surface;
7 a second optical element providing a second reflecting surface; and
8 a beam splitter positioned between the first and second optical elements,
9 wherein the beam splitter produces from the array of input beams a first array of
10 measurement beams and a second array of measurement beams,

11 wherein the first reflecting surface participates in focusing the first array of
12 measurement beams onto a first array of locations on a first object plane in object space
13 and the second reflecting surface participates in focusing the second array of
14 measurement beams onto a second array of locations on a second object plane in object
15 space, said first and second object planes being parallel to and displaced from each other,

16 wherein the first array of measurement beams generates a first array of return
17 beams from the object and the second array of measurement beams generates a second
18 array of return beams from the object,

19 wherein the first reflecting element participates in producing from the first array
20 of return beams a first array of converging beams that converge to a first array of spots on
21 a first image plane and the second reflecting element participates in producing from the
22 second array of return beams a second array of converging beams that converge onto a
23 second array of spots on a second image plane, said first and second image planes being
24 adjacent to and on opposite sides of the detector-side pinhole array, and

25 wherein the detector-side pinhole array combines the first and second arrays of
26 converging beams to form an array of output beams.

1 5. The differential interferometric confocal microscope of claim 4 wherein a
2 single pinhole array serves as both the source-side pinhole array and the detector-side
3 pinhole array.

1 6. The differential interferometric confocal microscope of claim 5, wherein the
2 first optical element is located between said single pinhole array and the beam splitter and
3 wherein the second optical element is located between a location at which the object is
4 positioned during use and the beam splitter, wherein the first reflecting surface has a
5 center of curvature for which there is a corresponding conjugate as viewed through the
6 beam splitter, and wherein the second reflecting surface has a center of curvature that is
7 displaced relative to the corresponding conjugate of the center of curvature of the first
8 reflecting surface.

1 7. The differential interferometric confocal microscope of claim 6, wherein the
2 conjugate of the center of curvature of the first reflecting surface and the center of

3 curvature of the second reflecting surface are displaced from each other in a first
4 direction that is normal to a plane defined by the beam splitter and in a second direction
5 that is parallel to the plane defined by the beam splitter.

1 8. The differential interferometric confocal microscope of claim 7, wherein the
2 first reflecting surface participates in focusing the first array of measurement beams via
3 the beam splitter onto the first array of locations and the second reflecting surface
4 participates in focusing the second array of measurement beams via the beam splitter
5 onto the second array of locations.

1 9. The differential interferometric confocal microscope of claim 8, wherein the
2 first reflecting element participates in combination with the beam splitter in producing the
3 first array of converging beams and the second reflecting element participates in
4 combination with the beam splitter in producing the second array of converging beams.

1 10. The differential interferometric confocal microscope of claim 9 wherein the
2 first reflecting surface is substantially concentric with a point on the object.

1 11. The differential interferometric confocal microscope of claim 9, wherein the
2 second optical element provides a refracting surface positioned between the object and
3 the beam splitter to receive light rays from the object.

1 12. The differential interferometric confocal microscope of claim 11, wherein the
2 first reflecting surface substantially conforms to a sphere having a first radius and the
3 refracting surface conforms to a sphere having a second radius, wherein the first radius is
4 greater than the second radius.

1 13. The differential interferometric confocal microscope of claim 9, wherein the
2 first optical element provides a refracting surface positioned between the beam splitter
3 and said single pinhole array.

1 14. The differential interferometric confocal microscope of claim 9 wherein the
2 second reflecting surface is substantially concentric with an image point on said single
3 pinhole array.

1 15. The differential interferometric confocal microscope of claim 13, wherein the
2 second reflecting surface substantially conforms to a sphere having a first radius and the
3 refracting surface conforms to a sphere having a second radius, wherein the first radius is
4 greater than the second radius.

1 16. The differential interferometric confocal microscope of claim 9, wherein said
2 single pinhole array is a two-dimensional array.

1 17. The differential interferometric confocal microscope of claim 16, wherein the
2 two-dimensional array is of equally-spaced holes.

1 18. The differential interferometric confocal microscope of claim 17, wherein the
2 equally-spaced holes are circular apertures.

1 19. The differential interferometric confocal microscope of claim 9, wherein the
2 first and second object planes are separated from each other on the order of the
3 longitudinal resolution of the differential confocal interferometric microscope.

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